



## AGRONOMY SERIES

# TIMELY INFORMATION

## Agriculture & Natural Resources

DEPARTMENT OF AGRONOMY & SOILS, AUBURN UNIVERSITY, AL 36849-5633

S-01-01

November, 2001

### **Late Fall and Winter Application of Nutrients to Cool-season Forages in Alabama**

Charles Mitchell ([cmitchel@acesag.auburn.edu](mailto:cmitchel@acesag.auburn.edu))

Extension Agronomist-Soils

A growing Alabama poultry industry is increasing the total amount of nutrients (primarily N and P) available for land application. Much of this is applied to pastures in close proximity to broiler houses where it is produced. Over application of nutrients (primarily nitrogen and phosphorus) in the form of manure and, in some cases, applications at times of the year when the crop or forage cannot use the nutrients is increasing the risk of non-point source pollution from agricultural lands.

The Alabama Department of Environmental Management's 1998 AFO/CAFO rules require all CAFOs (Concentrated Animal Feeding Operations e.g., poultry operations with greater than 125,000 birds) to file and implement a comprehensive nutrient/waste management plan. Smaller AFOs (animal feeding operations) do not have to file BUT must have a written nutrient management plan and implement best management practices as prescribed by the Natural Resources Conservation Service (NRCS) for Alabama. A WRITTEN nutrient management plan for the handling of all animal manure is one of the most critical best management practices.

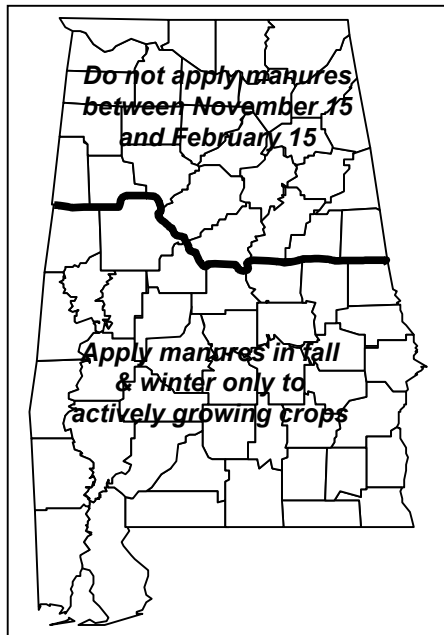
In 1999, USDA-NRCS at the national level changed its policies and practice standards related to nutrient management and the land application of animal manures. NRCS in Alabama implemented its nutrient management changes to reflect these national changes in May 2001. Some of the highlights of Alabama's new nutrient management standards (NRCS Code 590) include:

- Soil test every field where nutrients are applied at least every 3 years.
- Periodic manure testing (table values may be used in planning).
- Nitrogen rates should not exceed 10% of state Land Grant recommendations for the intended crop.
- Phosphorus rates should not exceed 10% of state Land Grant recommendations for the intended crop EXCEPT where animal manures and other organic byproducts are used.
- PHOSPHORUS INDEX will be used to make a risk assessment of each field where animal manures and other organic byproducts will be applied.
- Manures and organic byproducts are not to be applied within 3 days of a predicted storm event with >49% probability of rain.

ALABAMA A&M AND AUBURN UNIVERSITIES, AND TUSKEGEE UNIVERSITY, COUNTY GOVERNING BODIES AND USDA  
COOPERATING

The Alabama Cooperative Extension System offers educational programs, materials, and equal opportunity employment to all people without regard to race, color, national origin, religion, sex, age, veteran status, or disability.

•Nitrogen should be applied only to actively growing crops or within 30 days of planting. Therefore, no animal manures or organic byproducts are to be applied between November 15 and February 15 in North Alabama because rarely are crops actively growing during this period.



This last best management practice, illustrated in the adjacent figure, upset some producers and vendors who traditionally have applied poultry litter whenever the house is cleaned regardless of the time of year. This document explains the science, research, and reasoning behind this latter best management practice.

### Leaching and Runoff of Nutrients

Nutrients that are not taken up by the plant and removed from the land are either incorporated into soil organic matter (e.g., nitrogen in protein), fixed by soil inorganic minerals (e.g., phosphorus tied up as insoluble or sparingly soluble iron, aluminum, and calcium phosphates), held on the surface of soil minerals and organic matter (e.g., cation and anion exchange), or available as inorganic minerals in the

soil solution. Much of the applied fertilizer and organic nitrogen in Alabama ends up as inorganic minerals in the soil solution. Therefore, during the winter months when rainfall (precipitation) exceeds plant use and evaporation (evapotranspiration), nitrogen is subject to leaching. Surface-applied phosphorus may be transported off fields and into surface waters by runoff. Leaching and runoff are greatly reduced when plants are actively growing and plant use and evaporation exceeds rainfall during the summer months (Figure 2).

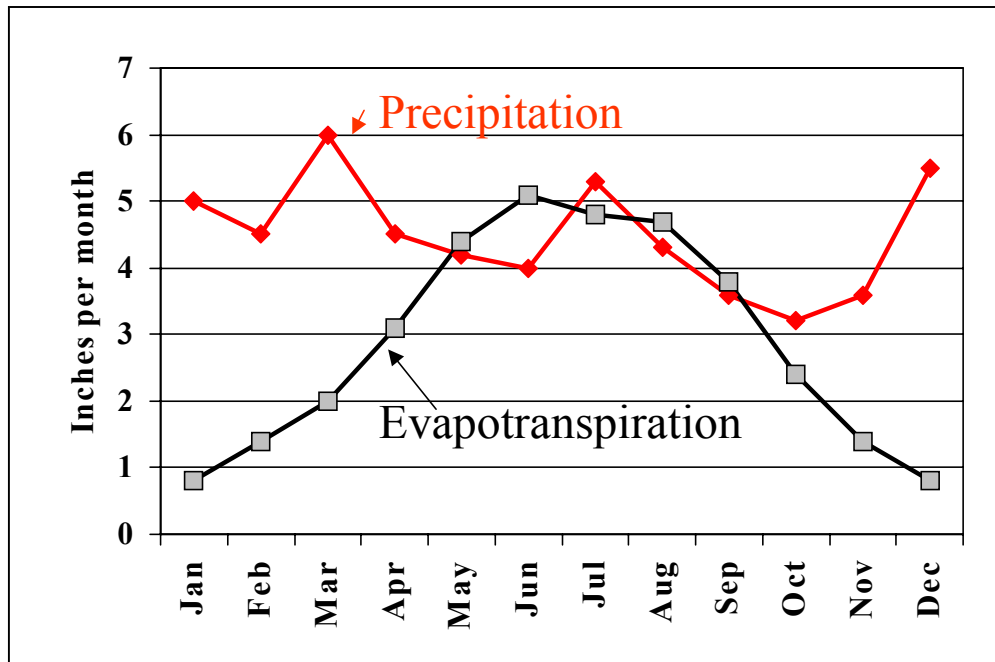


Figure 2. Average monthly rainfall (precipitation) and plant use and evaporation (evapotranspiration) for the Birmingham, Alabama area (from Ward, et al., 1959)

Nitrogen as nitrate ( $\text{NO}_3^-$ ) can leach quickly and deeply in a well drained Alabama soil. Figure 3 illustrates that the front of nitrate can be below 3 feet by the end of the summer growing season and more than 6 feet deep by the next spring. This occurred in both a Benndale sandy loam and a Lucedale sandy clay loam in Alabama under annual cotton production. By the fall, nitrate-N in the surface 30 inches of soil is the same as where no N was applied (Jackson, 1998). Kingery et al. (1994) found that fescue pastures receiving long-term applications of poultry litter in the Sandstone Plateau region of northern Alabama had high concentrations of soil nitrate-N extending to or near the bedrock (4+ feet). Wood et al. (1996) concluded that significant leaching of soil nitrate-N in the fall will occur when broiler litter is applied in excess of plant requirements for N. This latter research was on a Decatur silty clay in the Tennessee Valley.

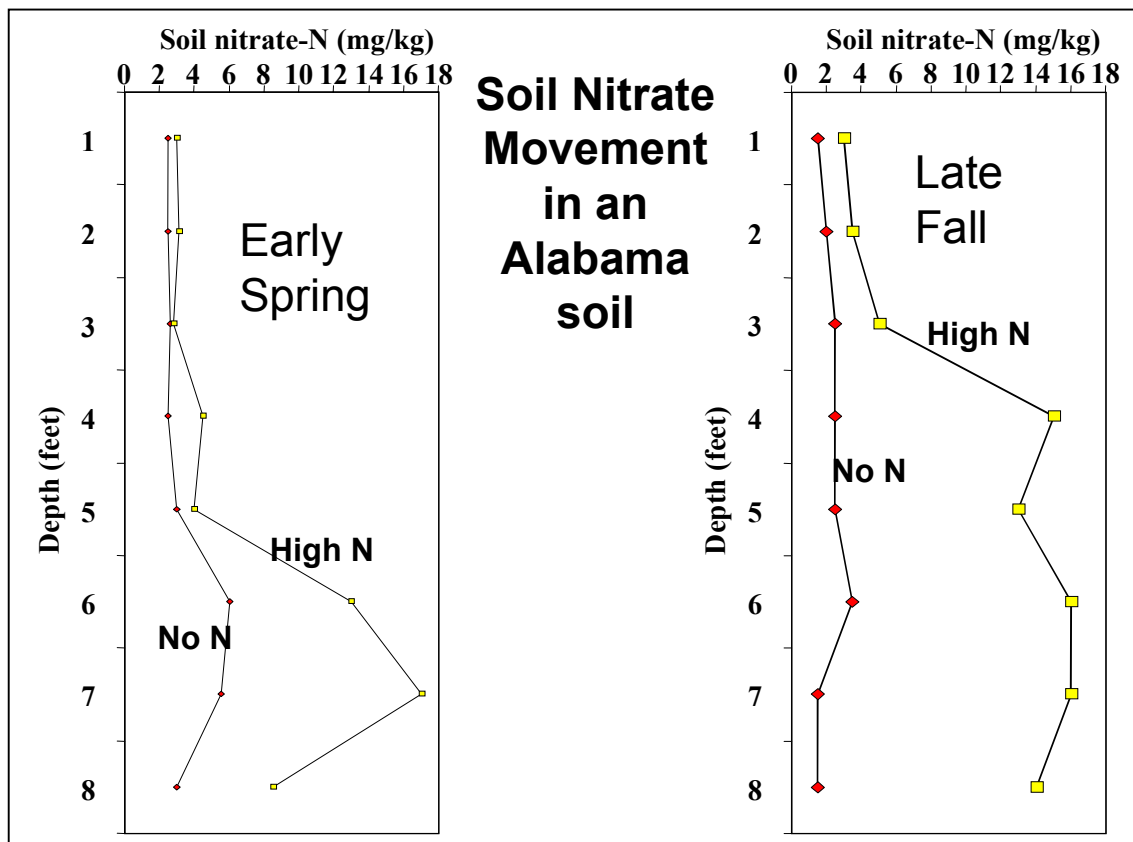


Figure 3. Soil nitrate movement in a Benndale sandy loam in cotton production where no nitrogen (No N) and 150 pounds N/acre/yr (High N) are applied. Samples were taken in the early spring before planting and again after cotton harvest in the late fall. (Jackson, 1998)

Evaluations of the presidedress soil nitrate test (PSNT) for corn in North Alabama in 1992-1994 indicated that when poultry broiler litter is applied more than 30 days before spring planting of corn, most of the nitrogen is lost. The PSNT failed to detect significant soil nitrate-N in the upper 2 feet of soil when broiler litter was fall or winter applied (Mitchell and Wood, 1992; Mitchell and Delaney, 1995).

The accumulation of excessive levels of soil P in surface soils where animal manures are applied as a source of N is well documented in Alabama (Kingery et al., 1993; Kingery et al., 1994; Wood et al., 1996). As early as the 1960s, the Auburn University Soil Testing

Laboratory instituted an "extremely high" soil test rating for phosphorus for those samples where extractable P ". . . is excessive and further additions may be detrimental" (Cope et al., 1970). Based upon extensive research throughout the U.S. with P loading and transport, USDA-NRCS encouraged development of the "phosphorus index" as a risk management tool to help in managing P on landscapes. Alabama's P index is based upon the original concept as presented by Lemunyon and Gilbert (1993). It contains factors for (1) soil test P value, (2) P application rate, (3) nutrient application method, (4) grazing animals, (5) underground outlet systems, (6) erosion rate, (7) hydrologic soil group, (8) field slope, (9) P application distance to water, (10) filter strip width, and (11) presence of impaired or outstanding waters of the State (USDA-NRCS, 2001).

### **Nutrient Applications to Actively Growing Crops**

Farmers interested in getting the most from their purchased fertilizer apply it at the time of year when the crop needs it. Usually most of the phosphorus (P) and potassium (K) and some of the nitrogen (N) is applied at or near planting or early in the growing season with the rest of the N applied later. Cotton and corn are NOT fertilized in the fall and bermudagrass is NOT fertilized in December. Comments on recommendations from the Auburn University Soil Testing Laboratory (Adams et al., 1994) usually specify the optimum time of nutrient applications.

*Comment for bermuda/bahia pasture: On summer grass pastures apply P and K as recommended and 60 pounds of N before growth starts. Repeat the N application up to September 1 when more growth is desired.*

*Comment for fescue pasture: Apply N, P, and K as recommended by September 1. Repeat N application in February.*

*Comment for small grains and ryegrass for grazing: For small grains and ryegrass planted on fallowed fields in early September for grazing, apply 100 pounds of N at planting and 60 pounds in early spring. Ryegrass planted alone for grazing should receive no more than 60 pounds of N in the fall and up to 100 pounds in the early spring. For grain only, apply 20 pounds N per acre in the fall and 60 to 80 pounds in the spring. The fall N can be eliminated following a good soybean crop or other legume.*

For row crops such as cotton and corn, split N applications are always recommended to avoid loss of nitrogen before the crop can use it during peak growth.

### **Dry Matter Yields of Cool-season Forages**

Cool season crops are popular in Alabama as forages. These include small grains (wheat, oats, rye, and triticale) and ryegrass planted for winter grazing. Cereal rye tends to produce more forage early in the season (fall and early spring) whereas ryegrass produces most of its growth later in the spring. Many annual and perennial legumes (clovers and vetch) make most of their growth in Alabama during the cool months of the year and greatly improve the quality of forages in a pasture. Tall fescue and orchardgrass are cool-season, perennial grasses that are particularly well adapted to the northern counties of Alabama. Most of the growth of tall fescue is in the fall and spring (Figure 4). Even mild Alabama winters can be severe enough to stop or greatly reduce the growth of cool-season crops. This is why the comments above specify that all of the P and K (which is not subject to leaching losses) be applied in the fall and most of the N be applied in split applications in the fall and again the following late winter or spring. No nutrients are

recommended during December and January when growth is very slow and rainfall exceeds plant water uptake plus evaporation.

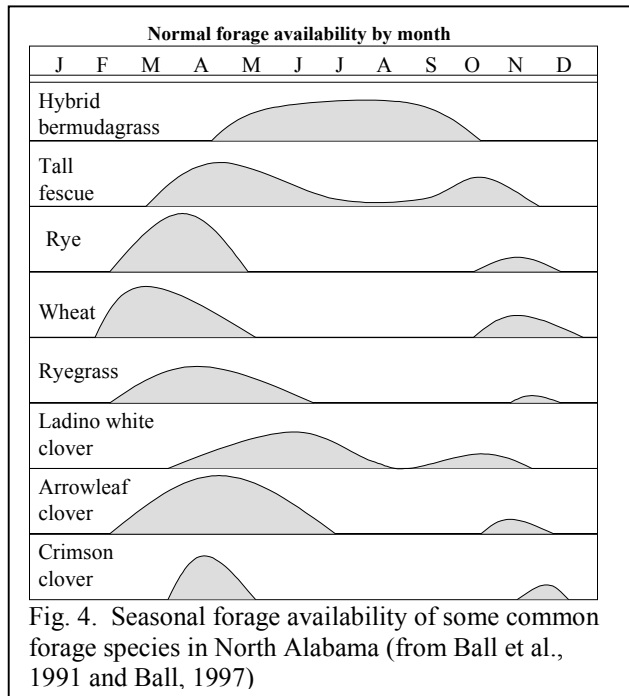


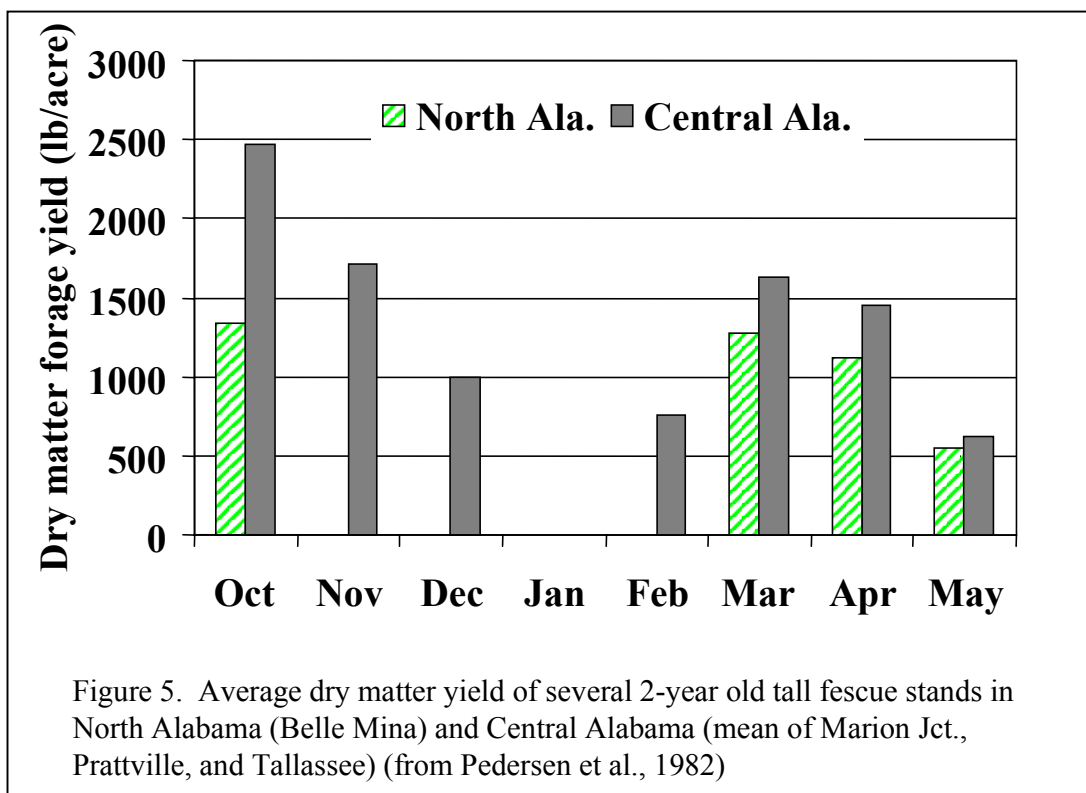
Table 1 was developed from the 1990 through 2001 Alabama Agricultural Experiment Station's report on "Small Grain Varieties for Forage". In the Small Grain Variety Test, small grains for forages are normally planted in late September to early October and fertilized with 100 pounds N per acre as noted in the comment above. Fall forage yields are the total produced through December. Winter yields are that produced in January and February. Very little growth is produced in the fall and winter in North and Central Alabama. The most productive small grain for North Alabama in the fall and winter appears to be rye with an average dry matter yield of 1,860 pounds during the fall and winter at

Belle Mina in the Tennessee Valley and 780 pounds per acre at Crossville on Sand Mountain. Interestingly, the Marion Junction (Black Belt) and the Camp Hill (Piedmont) locations in Central Alabama produced less than the Tennessee Valley. All the South Alabama locations produced more growth during the fall and winter compared to North Alabama.

Table 1. Mean fall and winter dry matter forage yields (pounds per acre) of small grains in Alabama, 1990-2001.

Location	n *	Wheat		Oats		Rye		Titicale	
		Fall	Winter	Fall	Winter	Fall	Winter	Fall	Winter
NORTH ALABAMA									
Belle Mina	7	300	880	300	600	580	1280	480	1000
Crossville	7	20	220	20	180	90	690	70	410
Winfield	7	30	1180	10	940	0	1510	0	1240
CENTRAL ALABAMA									
Marion Jct.	7	0	1400	0	1170	0	1340	0	1380
Tallassee	7	940	1380	920	1120	1380	1780	1040	1290
Prattville	7	50	1220	50	1080	100	1530	0	1100
Camp Hill	1	--	--	0	400	0	750	0	1100
SOUTH ALABAMA									
Camden	3	300	1170	310	1050	570	1460	400	1130
Monroeville	7	670	1820	670	1390	1030	1570	1040	1460
Headland	7	1050	2890	1220	3040	1530	3760	1370	3200
Brewton	2	610	1430	780	1300	1010	1540	1400	840
Fairhope	7	1310	2070	1480	1860	1700	1920	1590	1720

\* Number of observations during the period 1990-2001.



Tall fescue is capable of producing more fall growth than cool-season annuals because it is already established when the weather becomes cooler in the early fall. However, there can be considerable differences in growth patterns of fescue cultivars. Pedersen et al., 1982, and Odom and Pedersen, 1988, demonstrated that 'AU Triumph' tall fescue produced more fall and winter growth than 'Kentucky 31'. However, when growth is averaged over several cultivars and locations, no measurable yield was recorded in North Alabama during the period of November through February (Pedersen et al., 1982; Figure 5).

#### Nutrient Uptake in Late Fall and Winter

Using estimates for nutrient removal by cool-season forages published in Extension circular ANR-449 (Mitchell, 1999) and in the new USDA-NRCS Nutrient Management Code 590 tables and the dry matter yields for rye in Table 1, the following values are calculated for nutrient uptake during the fall and winter in Alabama:

Belle Mina (North).	31-5-26 lb/acre N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O
Crossville (North).	13-2-10 lb/acre N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O
Tallassee (Central).	52-8-44 lb/acre N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O
Headland (South).	87-13-74 lb/acre N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O

Considering that most forage produced during this period of time is grazed or stockpiled for later grazing and is not removed from the land and that cattle are generally not marketed during this time of year, most of the consumed nutrients in forage are recycled on the pastures. In fact, 300 pounds beef produced on fescue, orchardgrass, or ryegrass pasture will remove only 9-7-1 pounds N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O (Mitchell and Tyson, 2001). Any nutrients applied during this time of year will have a very high risk of leaching or runoff.

## Conclusions

From an agronomic and environmental standpoint, the application of nutrients, particularly N and P, during the late fall and early winter in North Alabama is not a sound practice. Rainfall often exceeds plant use plus evaporation, and growth and nutrient uptake of cool season forages and crops are very low. Only under unusually mild weather conditions and in certain locations would nutrient application be advisable in Central Alabama during this period. In most years, some growth of cool-season forages can be expected in South Alabama in November through January. A ton of poultry broiler litter when surface applied will provide approximately 47-58-45 pounds of available N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O (Mitchell and Tyson, 2001). This exceeds the average nutrient uptake by cool season forages in North Alabama. To reduce the risk of non-point source nutrient pollution and nutrient losses to the environment and to maximize the investment in fertilizer, all fall-applied nutrients should be applied in September as noted in existing comments that accompany soil test recommendations (Adams et al., 1994) or in Alabama Extension Cir. ANR-186 (Ball et al., 1980).

## References

- Adams, J.F., C.C. Mitchell, and H.H. Bryant. 1994. Soil test fertilizer recommendations for Alabama crops. Ala. Agric. Exp. Stn. Dep. Ser. No. 178. Auburn University, AL.
- Ball, Don. 1997. Choosing forages for maximum grazing availability. Ala. Coop. Ext. Serv. Cir. ANR-155. Auburn University, AL.
- Ball, D.M., C.S. Hoveland, and G.D. Lacefield. 1991. Southern forages. Potash & Phosphate Institute, Norcross, GA.
- Ball, D.M., R. Hoyum, and W. Faw. 1980. Alabama forage crop fertilization and liming guide. Ala. Coop. Ext. Cir. ANR-186. Auburn University, AL.
- Cope, J.T., Jr., J.T. Eason, and G. Simmons. 1970. Fertilizer recommendations and computer program key used by the Soil Testing Laboratory. Ala. Agric. Exp. Stn. Cir. 176. Auburn University, AL.
- Jackson, S.E. 1998. Nitrogen movement under long-term fertilization and cropping in two Alabama soils. M.S. Thesis. 84 pp. Auburn University, AL.
- Kingery, W.L., C.W. Wood, D.P. Delaney, J.C. Williams, and G.L. Mullins. 1993. Implications of long-term land application of poultry litter on tall fescue pastures. J. Prod. Agric. 6: 390-395.
- Kingery, W.L., C.W. Wood, D.P. Delaney, J.C. Williams, and G.L. Mullins. 1994. Impact of long-term land application of broiler litter on environmentally related soil properties. J. Environ. Qual. 23: 139-147.
- Lemunyon, J.L., and R.G. Gilbert. 1993. The concept and need for a phosphorus assessment tool. J. Prod. Agric. 6:483-486.
- Mitchell, C.C. 1999. Nutrient removal by Alabama crops. Ala. Coop. Ext. Cir. ANR-449. Auburn University, AL.
- Mitchell, C.C., and F.H. Wood. 1992. Evaluation of the presidedress nitrate soil test on corn. Extension New Tech. Demo. Rep. No. S-06-92. Ala. Coop. Ext. Serv., Auburn University, AL.
- Mitchell, C.C., and D. Delaney. 1995. The presidedress soil nitrate test on corn - summary of 1992-1994 on-farm tests. Extension New Tech. Demo. Rep. No. S-01-95. Ala. Coop. Ext. Serv., Auburn University, AL.
- Mitchell, C.C., and T.W. Tyson. 2001. Nutrient management planning for small AFOs: broiler operations. Ala. Coop. Ext. Cir. ANR-926. Auburn University, AL.

Odom, J.W., and J.F. Pedersen. 1988. Levels and timing of nitrogen fertilizer applications for tall fescue in Central Alabama. Ala. Agric. Exp. Stn. Cir. 292. Auburn University, AL.

Pedersen, J.F., C.S. Hoveland, and R.L. Haaland. 1982. Performance of tall fescue varieties in Alabama. Ala. Agric. Exp. Stn. Cir. 262. Auburn University, AL.

Wood, B.H., C.W. Wood, K.H. Yoo, K.S. Yoon, and D.P. Delaney. 1996. Nutrient accumulation and nitrate leaching under broiler litter amended corn fields. Commun. Soil Sci. Plant Anal. 27: 2875-2894.

USDA-NRCS. 2001. Phosphorus index for Alabama - a planning tool to assess and manage P movement. Agronomy Tech. Note no. 72. USDA Natural Resources Conservation Service, Auburn, AL.

Ward, H.S., C.H.M. van Bavel, J.T. Cope, Jr., L.M. Ware, and H. Bouwer. 1959. Agricultural drought in Alabama. Ala. Agric. Exp. Stn. Bul. 316. Auburn, AL

### **Acknowledgements**

A special thank you to Ms. Brenda Wood and Ms. Kathy Glass in the Agronomy & Soils Department and Mr. Ted Tyson in the Department of Biosystems Engineering at Auburn University and Mr. Ken Rogers, Mr. Perry Oakes, and Mr. Bill Prince with USDA-NRCS for reviewing this publication.